xc: Larry Beutcik
& Greg Beck

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FAILURE ANALYSIS AND PRELIMINARY CORRECTIVE ACTION WORK PLAN

AVERY LANDING SITE
AVERY, IDAHO

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WITH HANDWRITTEN CORRECTIONS

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1.0 INTRODUCTION

Farallon Consulting, L.L.C. (Farallon) has prepared this Failure Analysis and Preliminary Corrective Action Work Plan (Work Plan) on behalf of the Potlatch Forest Products Corporation to address the Idaho Department of Environmental Quality (DEQ) requirements regarding the discharge of light non-aqueous phase liquid (LNAPL) as oil from the Avery Landing site (herein referred to as the Site) (Figure 1) to the St. Joe River. The Site is located along railroad tracks and was the former location of a railroad roundhouse and maintenance yard. The LNAPL is attributed to releases associated with the former maintenance operations at the Site.

A remedial action conducted at the Site in ~~2001~~ 2000 included installation of a containment wall and collection wells to stop the migration of LNAPL from the Site to the St. Joe River. Annual monitoring events have been conducted at the Site since ~~2001~~ 2000 to document groundwater conditions and LNAPL thicknesses and confirm that the containment wall is working as intended. During the annual monitoring event on September 25, 2005, LNAPL was observed seeping from the river bank and a sheen on the surface of the river was near collection well CW-3 (Figure 2). DEQ was notified of these observations in a letter dated October 3, 2005 regarding *Avery Landing Monitoring - 2005*, prepared by Potlatch Corporation (Potlatch 2005). In accordance with the monitoring requirements, appropriate remedial actions are required by DEQ to address the release of LNAPL to the river.

1.1 PURPOSE

The purpose of the Work Plan is to provide a scope of work to determine the migration pathway of the LNAPL from the Site to the river, provide alternatives of interim actions that may be necessary, and present an evaluation of preliminary alternatives to prevent future releases of LNAPL to the river.

2.0 BACKGROUND

The Site is located in Shoshone County, Idaho in the northeast corner of Section 15 and the northwest corner of Section 16 of Township 45 North, Range 5 East. The Site is approximately four acres and is located approximately 0.5-mile west of Avery, Idaho along the St. Joe River at approximately River Mile 64.5. According to the United States Geological Survey (USGS) topographic map for the Site vicinity, the elevation of the Site is approximately 2,480 feet above mean sea level (msl). The Site is currently a vacant parcel bordered to the north by Highway 50, to the south by the St. Joe River and to the east and west by private residences.

The Site was used by the Milwaukee Railroad, that is no longer a viable entity, as its log loading station and round house maintenance facility. It is suspected that the contamination at the Site is associated with the railroad activities. The petroleum impacted area was estimated by Hart Crowser at 92,000 square feet ranging in depth from the 3 to 18 feet below grade surface (Hart Crowser 2000).

Hart Crowser Inc. operated an LNAPL from 1994 to 2000 that consisted of four large recovery trenches with LNAPL skimming equipment in each trench. Water was extracted from the trenches and pumped across Highway 50 to create a "trough" of area that would contain the LNAPL that migrated toward the St. Joe River. The LNAPL skimming equipment collected the LNAPL and pumped it to an onsite storage tank. A total of ~~775~~ 1290 gallons of LNAPL was removed by the system.

The LNAPL removal system did not fully mitigate the migration of LNAPL into the St. Joe River; therefore, Potlatch decided to install a containment wall along the river bank. Approximately 650 linear feet of the St. Joe River bank was excavated and a PVC liner was installed from the top of the bank to below the surface water level in the summer of 2000. Figure 3 depicts the installation area.

Potlatch presented the remediation and project schedule in a letter dated December 21, 2001 (Potlatch 2001) that included annual LNALPL monitoring during August or September 2000. The monitoring plan included the requirement that measurable oil of 0.05-feet or greater would trigger active LNAPL recovery from the collection wells. The monitoring scope of work included monitoring of visible evidence of the surface water in the river and the river bank for any sign of oil sheen on the water surface or LNAPL in the water.

The annual monitoring and sampling for 2005 was conducted on September 29. Groundwater level measurements were measured to be lower than previous measurements and the river level was noted to be low. The thickness of LNAPL measured in monitoring wells on September 29, 2005 ranged from 0.01 feet to 0.04 feet (Potlatch 2005) (Table 1). Visual inspection of the river bank identified discharge of LNAPL and water with an oily sheet to the river channel.

3.0 PRELIMINARY EVALUATION OF FAILURE ALTERNATIVES

The release of LNAPL as oil observed along the river bank on September 29, 2005 is likely due to some type of failure of the containment wall. The potential failure mechanisms include a tear in the liner or a breach of the containment wall. A preliminary evaluation of each of these potential failure mechanisms is presented in the following sections.

3.1 CONTAINMENT WALL TEAR

The containment wall is composed of 30-mil PVC alloy liner that is protected by geotextile fabric and covered with clean fill, crushed rock, and rip rap along the river bank. The observation of LNAPL as oil seeping out from the river bank near collection well CW-3 in September 2005 could be the result of a tear in the liner. A tear in the liner would provide a migration pathway for oil to the river bank at certain groundwater elevations.

3.2 CONTAINMENT WALL BREACH

The observation of LNAPL as oil seeping from the river bank near collection well CW-3 in September 2005 could be the results of a breach in the containment wall by migration of oil either around the east and/or west ends of the containment wall, beneath the containment wall, or over the top of the containment wall. Since the top of the containment wall extends almost to the top of the bank and the depth to groundwater and LNAPL is generally between 12 to 18 feet below the top of the well casings at the top of the bank, it is unlikely that oil is breaching the top of the containment wall. A preliminary evaluation of the failure mechanism of a horizontal breach (migration of oil either around the end(s) of the containment wall), or of a vertical breach (migration of oil under the containment wall) is provided in the following sections.

3.2.1 Horizontal Breach

The monitoring plan described in the Corrective Action Plan (Hart Crowser 2000) provided guidelines for monitoring and removal of LNAPL in the collection wells to prevent migration of LNAPL as oil around the east and west ends of the containment wall. Calculations conducted prior to installation of the containment wall estimated the volume of LNAPL at the containment wall that would result in a horizontal breach. The calculations were based on an assumed 10-foot smear zone and the distance from the ends of the containment wall to collection wells CW-1 and CW-5 (Figure 3). The results of the calculations were used to develop the long term monitoring plan. In order to prevent a breach of the containment wall, it was determined that LNAPL exceeding 2-feet in thickness in any of the collection wells would trigger active recovery of the LNAPL from the collection well. Since monitoring of the containment wall began in 2000, LNAPL has not been identified at measurable thicknesses in any of the collection wells.

However, the changes that the containment wall has had on the groundwater flow regime at the Site have not been evaluated. It is possible that new groundwater flow paths have developed since installation of the containment wall and that the LNAPL as oil is migrating on groundwater around the containment wall.

3.2.2 Vertical Breach

The containment wall was installed with the bottom of the liner set approximately 2 feet below the low water mark of the river in the Summer of 2000. The field notes documenting conditions at the Site on September 29, 2005 indicate that the water level of the river was very low. The USGS operates and maintains a river gaging station on the St. Joe River near River Mile 43 at the town of Calder, Idaho. The river at Calder, Idaho is located at an elevation of approximately 2,180 feet msl and the gage datum is 2,171.76 feet msl (relative to the National Geodetic Vertical Datum 29 [NGVD29]). The stream gauge measurements on September 15 2005 indicated that the river level was at 5.06 feet above the gage datum, or 2176.82 feet above sea level. In 2000, when the containment wall was installed, the river level was measured at 4.65 feet above the gage datum at Calder, an even lower river level than in 2005. Table 1 presents the St. Joe River data at the Calder gauge from 1994 until 2005.

Measured depths to groundwater during the September 2005 monitoring event indicate that the depth to groundwater at the Site ranged from 11.23 feet to 23.06 feet below the top of the well casings, with an average depth to groundwater from the 26 monitoring points of 16 feet below the top of the well casings. The lowest recorded depth to groundwater in monitoring well EW-2, monitoring well located closest to the observed LNAPL seepage, for the 10 year period that it has been monitored, the lowest recorded reading was 79.65 in 2005. Table 1 presents the groundwater elevation at monitoring well EW-2 from 1994 to 2005.

4.0 ASSESSMENT OF FAILURE ALTERNATIVES

There is insufficient data to determine the failure mechanism for the containment wall. Additional evaluation during low water will be necessary to evaluate the failure mechanism in order to develop a remedial action. The following scope of work will evaluate the cause of the failure of the containment wall. The assessment will include the following elements:

- Survey the elevations of the collection wells, the top of the containment wall, the top and toe of the river bank, and the river height in with the surveyed monitoring well network at the Site;
- Measure groundwater and LNAPL levels in all of the wells at the Site;
- Visually inspect and photograph document the condition of the river bank and containment wall;
- Model the groundwater flow between the Site and the river; and
- Evaluate the fate and transport mechanisms of the LNAPL.

An elevation survey will be conducted of all Site features, including monitoring wells, extraction wells, collection wells, the top of the containment wall, the top of the river bank, the estimated base of the containment wall and the river level. All of these elements will be incorporated into hydrogeologic models to determine the migration pathway for LNAPL as oil to reach the river bank. Groundwater and LNAPL levels will be measured monthly for four months during the summer to determine the groundwater-surface water interaction with the containment wall during low water season. The USGS measures and records river levels monthly. The USGS real-time data will be monitored and compared to groundwater levels at the Site.

The groundwater flow regime at the Site will be evaluated with the new data to determine if a horizontal or vertical breach of the containment wall appears likely. If it does not appear that the release of LNAPL as oil to the river is a result of a breach of the containment wall, it will be assumed that a tear in the wall is the cause of the release.

5.0 PRELIMINARY EVALUATION OF REMEDIAL ALTERNATIVES

Based on the results of the assessment outlined in Section 4.0, a detailed evaluation of remedial alternatives will be conducted to address the apparent cause of containment wall failure. These alternatives will include permanent alternatives, such as repairs to the liner, and institutional controls; or temporary alternatives that may be implemented as needed to impede migration of LNAPL to the river. A preliminary evaluation of potential remedial alternatives that may be technically feasible for each potential failure mechanism is provided in the following sections.

5.1 CONTAINMENT WALL TEAR

A tear in the containment wall can only be confirmed and repaired by removing the fill, rock, and rip rap overlying the PVC liner and geotextile fabric. If the failure assessment does not indicate that a breach of the containment wall is the cause of the release of LNAPL as oil to the river, the PVC liner will be uncovered and inspected near the location of collection well CW-3, where the oil seepage was observed. The condition of the liner will be photographed and documented. If a tear is confirmed, the containment wall will be repaired.

5.2 HORIZONTAL BREACH

A horizontal breach in the containment wall will require an institutional control to prevent migration of groundwater and LNAPL around one, or both, ends of the wall. Depending on the results of the groundwater flow modeling and fate and transport evaluation of LNAPL, the remedial alternatives may include pumping and/or injection of groundwater from one or more specific locations to contain the LNAPL to the Site, or other measures.

5.3 VERTICAL BREACH

A vertical breach in the containment wall may require implementation of controls to reduce migration of oil beneath the wall when groundwater levels and the river water level are lowest. The river water level and groundwater level at the Site will be monitored and controls will be implemented when those levels drop below a threshold, determined by the evaluation, that could result in the release of oil to the river. The controls may consist of deploying booms and absorbent pads, or other measures, to collect oil before it reaches the water of the river.

6.0 INTERIM ACTION PLAN

In order to minimize the impact of LNAPL oil migrating past the containment wall, oil absorbent booms will be implemented at all times the St. Joe River is below high water level. Farallon estimates the booms may be required from late April until December until the LNAPL migration has been mitigated. Inspections and documentation of the inspections of the booms will be required every two weeks for the following:

- Boom Integrity – Boom buoyancy is adequate, minimal sunlight degradation has occurred and the boom is still anchored to the river wall properly;
- Boom Oil Saturation – Booms do not show excess staining and no oil is present behind the booms;
- Boom Staining Documentation – Staining of the booms shall be documented by both a narrative and digital photography; and
- Boom Replacement – Replacement booms will be stored on site and be replaced during the inspection site visit if needed.

Used booms will be temporarily stored on Site for final disposal off site at the end of each season. An operation and monitoring plan for the interim action will be prepared by Potlatch and submitted to DEQ to guide the interim action.

7.0 REMEDIAL ALTERNATIVE IMPLEMENTATION PLAN

Following determination of the failure mechanism, Farallon will evaluate feasible remedial alternatives and prepare a Remedial Action Work Plan that will provide details for implementation of the selected remedial alternative. The Work Plan will provide a detailed description of the schedule for implementation of the selected remedial alternative. Farallon anticipates the evaluation study will be completed in November 2006, after all of the low water data have been collected and analyzed. If the selected alternative involves in water work, Farallon estimates the alternative implementation will occur during the summer of 2007 during the low water season to allow for the necessary permits.

8.0 REFERENCES

Hart Crowser. 2000. *Corrective Action Plan, Avery Landing Site.* Prepared by Mr. Terry Montoya and Mr. Mathew F. Schultz for Mr. Norm Linton. Area Manager, Potlatch Corporation. July 27.

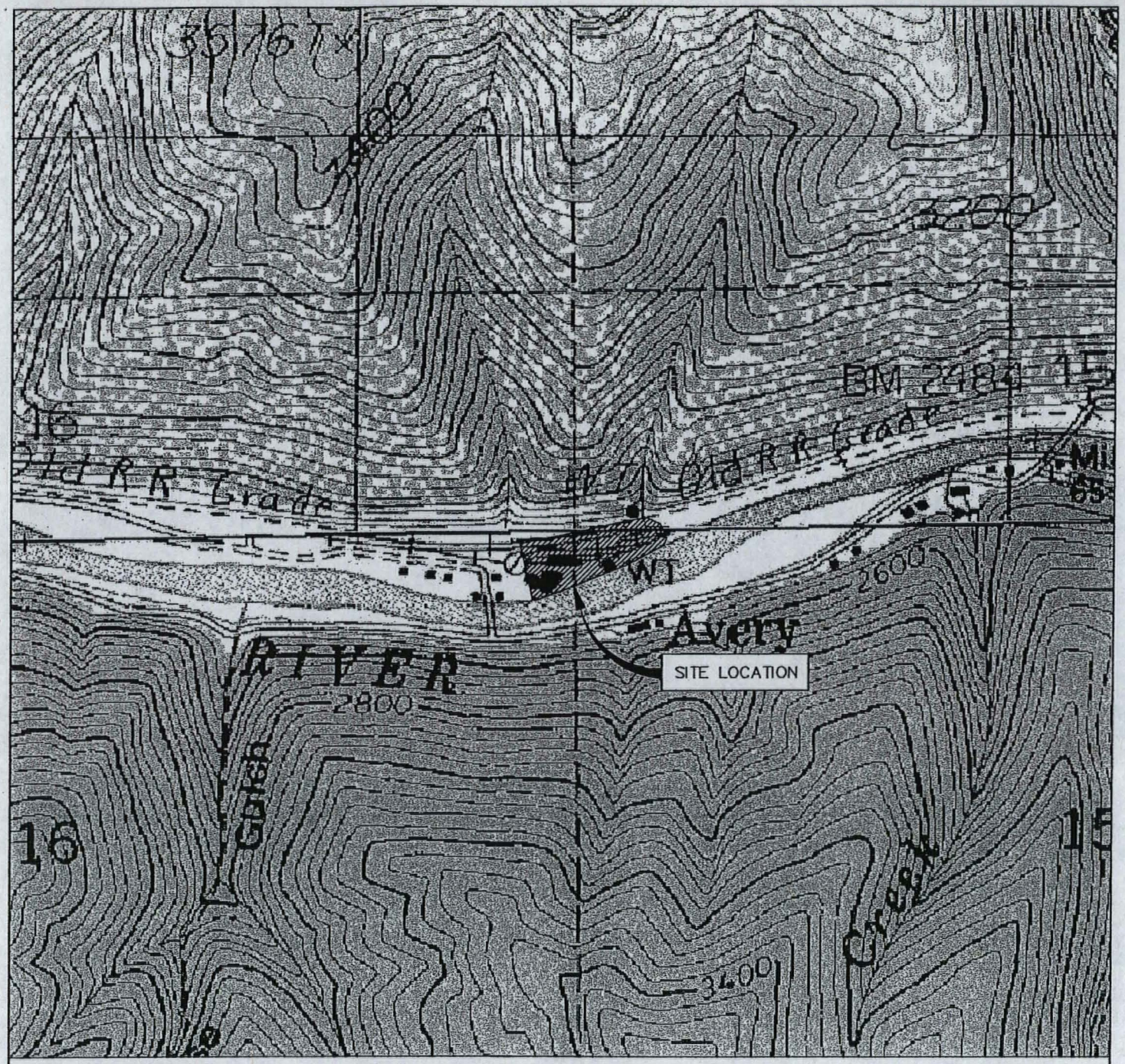
Potlatch Corporation. 2001. Letter Regarding Avery Landing Remediation and Project Schedule. From Mr. Norm Linton, Potlatch Corporation Area Manager. To Mr. Kreg Beck. State of Idaho, Division of Environmental Quality. December 21.

Potlatch Corporation. 2005. Letter Regarding Avery Landing Monitoring – 2005. From Mr. Norm Linton, Potlatch Corporation Area Manager. To Mr. Mar Kalbaugh. State of Idaho, Division of Environmental Quality. October 3.

FIGURES

Failure Analysis and Preliminary Corrective Action Work Plan
Avery Landing Site
Avery, Idaho

Farallon PN: 496-001



SOURCE: TERRACERVER-USA
NOT TO SCALE

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FIGURE 1

SITE VICINITY MAP
AVERY LANDING
AVERY, IDAHO

FARALLON PN: 496-001

Drawn By: DEW	Checked By: CB/TM	Date: 3/17/06	Disk Reference: 496001

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FIGURE 2

SITE AERIAL PHOTOGRAPH–1998
AVERY LANDING
AVERY, IDAHO

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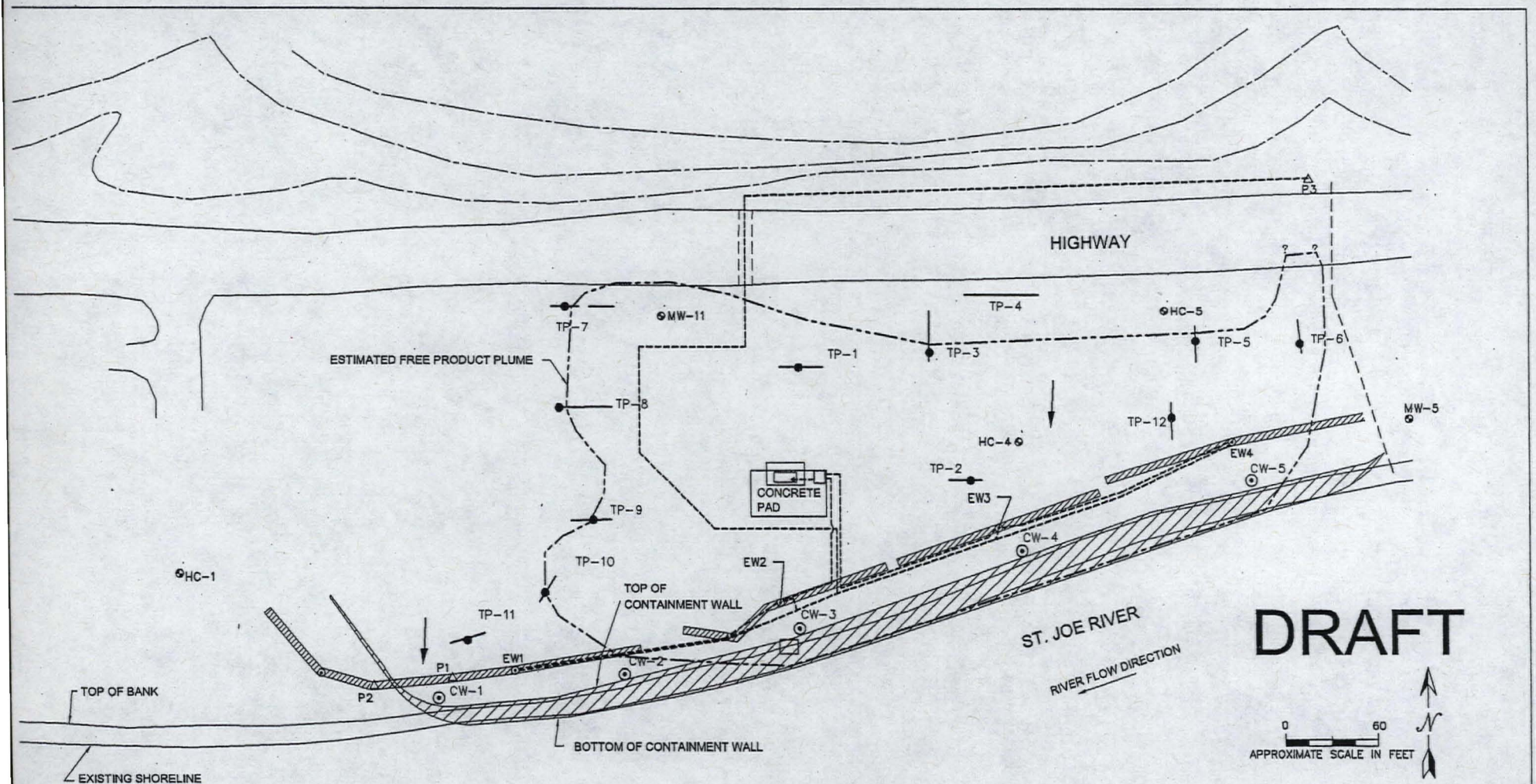
Drawn By: DEW	Checked By: CB/TM	Date: 3/17/06	Disk Reference: 496001



BASED ON HART CROWSER FIGURE 4 CORRECTIVE ACTION PLAN 7/00

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FIGURE 3
SITE PLAN
AVERY LANDING
AVERY, IDAHO

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TABLE

Failure Analysis and Preliminary Corrective Action Work Plan
Avery Landing Site
Avery, Idaho

Farallon PN: 496-001

Table 1
Groundwater and River Elevations
Avery Landing
Avery, Idaho
Farallon PN: 496-001

Monitoring Location	TOC Elevation[1]	Date	Depth to LNAPL	Depth to Groundwater	LNAPL Thickness	Groundwater Elevation[1]	Date	River Elevation[2]
EW-2	95.24	10/27/1994	NM	10.37	0	84.87	10/19/1994	2176.34
		6/30/1995	10.57	10.89	0.32	84.35	7/13/1995	2177.76
		9/21/1995	13.9	13.92	0.02	81.32	8/31/1995	2176.81
		7/11/1996	11.03	11.66	0.63	83.58	NA	NA
		9/11/1996	NM	14	0	81.24	10/23/1996	2177.34
		11/5/1996	NM	12.27	0	82.97	NA	NA
		7/17/1997	8.99	9.09	0.1	86.15	7/1/1997	2180.55
		10/9/1997	NM	15.44	0	79.8	10/16/1997	2177.5
		6/25/1998	9.19	9.64	0.45	85.6	6/2/1998	2180.58
		8/12/1998	NA	9.99	NA	NA	7/28/1998	2177.63
		10/22/1998	NM	10.94	0	84.3	10/7/1998	2176.99
		3/18/1999	10.17	10.27	0.1	84.97	3/29/1999	2179.88
		6/22/1999	11.3	11.31	0.01	83.93	7/7/1999	2179.65
		9/16/1999	15.32	15.35	0.03	79.89	9/9/1999	2177.16
		12/2/1999	9.91	10.1	0.19	85.14	12/8/1999	2177.91
		3/30/2000	9.5	10.29	0.79	84.95	3/15/2000	2178.55
		6/14/2000	8.89	9.39	0.5	85.85	5/25/2000	2181.37
		11/8/2000	NM	15.25	0	79.99	11/29/2000	2176.77
		12/4/2000	14.19	NA	NA	NA	NA	NA
		1/16/2001	14.6	NA	NA	NA	1/9/2001	2176.45
		2/15/2001	14.34	14.36	0.02	80.88	2/27/2001	2176.49
		3/16/2001	14.75	14.78	0.03	80.46	NA	NA
		4/18/2001	14.6	NA	NA	NA	4/11/2001	2177.6
		5/15/2001	11.53	11.54	0.01	83.7	5/2/2001	2180.8
		6/20/2001	14.1	NA	NA	NA	6/26/2001	2177.83
		7/21/2001	14.95	15	0.05	80.24	7/18/2001	2177.16
		8/21/2001	15.34	15.38	0.04	79.86	NA	NA
		9/28/2001	15.62	15.67	0.05	79.57	9/18/2001	2176.33
		10/31/2001	14.62	14.65	0.03	80.59	10/25/2001	2176.68
		10/4/2002	15.25	15.28	0.03	79.96	10/1/2002	2177.07
		9/26/2003	15.59	15.62	0.03	79.62	9/15/2003	2176.81
		9/24/2004	15.04	15.07	0.03	80.17	9/21/2004	2177.33
		9/29/2005	15.58	15.59	0.01	79.65	9/15/2005	2176.82

[1]Elevations relative to arbitrary Site datum

[2]River elevation as measured by USGS at gaging station 12414500 at Calder, Idaho, above mean sea level NGVD29.

LNAPL = light non-aqeuous phase liquid

NA = Data not available

NGVD29 = National Geodetic Vertical Datum 29

NM = No measurable thickness of LNAPL

TOC = top of casing